Assimilative Capacity Factor Calculations

According to the EPA Administrator's letter, "while the point of exposure to radionuclides used for identifying risk and setting appropriate effluent limits may be downstream of the discharge point…the point of compliance for meeting the final effluent limits must be at the point of discharge" (EPA 2020, p.13). The recreational fishing receptor at downstream points of exposure and upstream point of compliance discharge limits are separate and distinct locations with separate and distinct radionuclide concentrations. The radionuclides discharges at the upstream point of compliance (i.e., rad discharge limits), entering Bear Creek at the pipe discharge and assimilating into Bear Creek (i.e., instream or water column concentration). Consistent with EPA guidance, radionuclide discharge limits for each radionuclide recognizes the assimilative capacity or mixing of the stream at the pipe discharge point.

The assimilative capacity factor used in this calculation is based on landfill wastewater discharge to Bear Creek near BCK 8.5.[1] This location represents an estimated location based on the planned EMDF site, and anticipated landfill wastewater being discharged at the Bear Creek stream location near EMDF. The assimilative capacity factor calculated at the potential point of discharge (BCK 8.5) will be used for all downstream point of exposure (POE) locations. Specifically, these POEs include BCK 3.3, BCK 0.5, and EFK 0.0. While further mixing and dilution will occur downstream of BCK 8.5, credit for assimilative mixing will only be taken at the point of discharge (in this case, BCK 8.5), and the same factor will be applied at all POEs for purposes of calculating the rad discharge limits.

The nearby flow monitoring station at BCK 9.2 offers an abundance of historical flow data. Because of its close upstream proximity Bear Creek flow data from BCK 9.2 (upstream of BCK 8.5) will be used to conservatively evaluate the mixing zone at the pipe discharge location BCK 8.5. For parameter distributions that span wide ranges of value, the median is often the better central tendency statistic than the mean since the mean can be greatly affected by high or low values. Also, using the median recognizes that landfill wastewater discharges are correlated with rain events, not dry weather. That is, wastewater releases are driven by, and associated with rain/storm events; consequently using minimum flow rates is not credible/reasonable. Further, the use of the median flow rate is consistent with long-term fish bioaccumulation phenomena. The 10-year (2010 to 2020) median flow at BCK 9.2 is 622 gallons per minute (Fig. 1).

[1] A primary assumption in this analysis is that the pipe discharge location will be located near the proposed EMDF location (near BCK 8.5). If the pipe discharge location changes, the same approach described herein for calculating assimilative capacity factor will be used based on an estimated stream flow rate at the revised pipe discharge location.

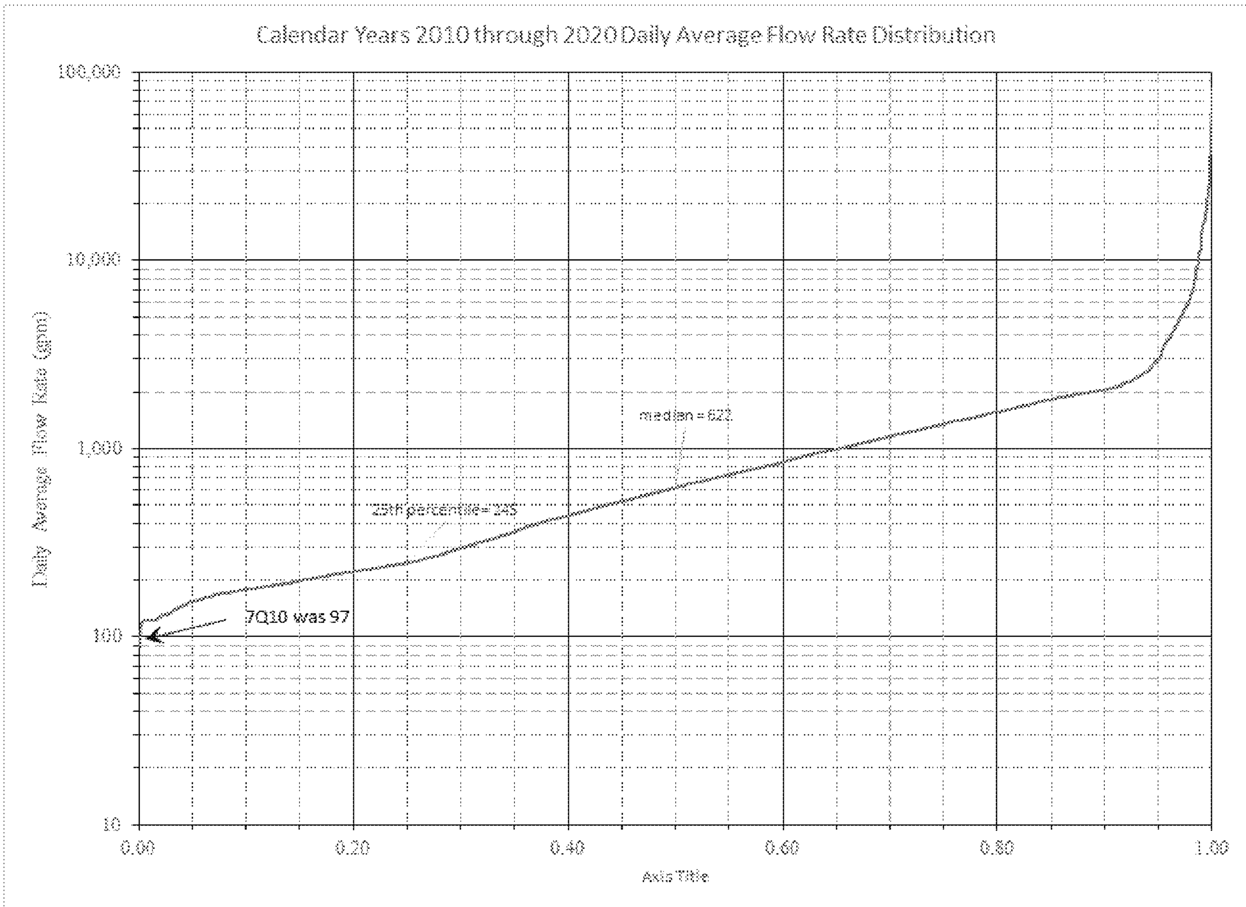

Fig. 1 Daily average flow rate in gallons per minute at BCK 9.2 flow monitoring station.

EPA mass balance approach was used to calculate an appropriate mixing factor at the pipe discharge point. The equation used by EPA is as follows:

$$C_t \times Q_t = (C_{dis} \times Q_{dis}) + (C_b \times Q_b)$$

where t is the combined mixing zone, C_t is instream target concentration, Q_t is combined flow rate in Bear Creek at discharge point (BCK 8.5), C_{dis} is rad discharge limit, Q_{dis} is landfill discharge flow rate, C_b is baseline rad concentration in Bear Creek, and Q_b is baseline stream flow rate. The equation can be rearranged to calculate the rad discharge limit, C_{dis}:

$$C_{dis} = [C_t \times Q_t - C_b \times Q_b]/Q_{dis}$$

Recognizing that the baseline water concentration in Bear Creek is zero for most radionuclides (with possible exception of uranium isotopes), the equation can be further simplified:

$$C_{dis} = [C_t \times Q_t]/ Q_{dis} = C_t \times [Q_t/Q_{dis}],$$

where Q_t/Q_{dis} is the assimilative mixing/capacity factor at the pipe discharge.

Based on the anticipated flow from EMDF (and EMWMF) of 50,000 gallons per day, or 34.7 gallons per minute. The assimilative mixing factor can be calculated:

$$\text{Assimilative Mixing Factor} = Q_t/Q_{dis} = 622/34.7 = \mathbf{17.9}$$

The assimilative mixing at BCK 8.5 is assumed to be same mixing available at all downstream POEs—i.e., no further credit is take for mixing/dilution. This mixing factor of 17.9 allows the water-equivalent PRG to be increased by this factor to recognize that the radionuclide discharge has an assimilative capacity afforded by mixing in Bear Creek before it reaches the POE. Therefore, the rad discharge limits for each radionuclides are determined by taking credit for assimilative mixing as follows:

Rad discharge limit = water column PRG x assimilative mixing factor